IN THE CLAIMS

1. (original) A method for predicting train consist reactions to specific stimuli using a system including at least one measurement sensor located on a train consist, a data base, and a computer, the train consist including at least one locomotive and at least one railcar, said method comprising the steps of:

collecting sensor data as the consist is moving;

determining a consist force balance utilizing the sensor data and the computer;

determining a set of consist coefficients using the computer; and

predicting train consist kinetic characteristic values using the consist force balance and the set of consist coefficients.

2. (original) A method in accordance with Claim 1 wherein said step of collecting sensor data comprises the steps of:

monitoring a force applied to the consist utilizing the at least one measurement sensor;

generating force data with respect to the force applied; and

communicating the force data to the computer.

3. (original) A method in accordance with Claim 1 wherein said step of determining a consist force balance comprises the step of determining a set of consist kinetic elements.

4. (previously presented) A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements comprises the step of determining rolling forces according to the equation:

$$F_{(rf)} = M\,(K_r + K_{rv}\,v(t))$$

wherein

$F_{(rf)}$ relates to the rolling forces of the train;

M is the total train mass;

K_r is the corrective factor for friction of the train;

K_{rv} is the dynamic corrective factor for friction of the train; and

v(t) is the speed of the train as a function of time.

5. (previously presented) A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements further comprises the step of determining aerodynamic forces according to the equation:

$$F_{(af)} = K_a \, v(t)^2$$

wherein

$F_{(af)}$ relates to the aerodynamic forces of the train;

K_a is the corrective factor for the effect of the aerodynamic friction; and

v(t) is the speed of the train as a function of time.

6. (previously presented) A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements further comprises the step of determining elevation caused forces according to the equation:

$$F_{(ef)} = M\,(K_{e1}\,E_1(t) + K_{e2}\,E_2(t) + K_{e3}\,E_3(t) + K_{e4}\,E_4(t))$$

wherein

$F_{(ef)}$ relates to the elevation caused forces of the train;

M is the total train mass;

K_{e1} is the corrective factor for the effect of the elevation change on a first segment of the train;

$E_1(t)$ is the elevation function relating to the first segment;

K_{e2} is the corrective factor for the effect of the elevation change on a second segment of the train;

$E_2(t)$ is the elevation function relating to the second segment;

K_{e3} is the corrective factor for the effect of the elevation change on a third segment of the train;

$E_3(t)$ is the elevation function relating to the third segment;

K_{e4} is the corrective factor for the effect of the elevation change on a fourth segment of the train; and

$E_4(t)$ is the elevation function relating to the fourth segment.

7. (previously presented) A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements further comprises the step of determining braking forces caused by direction changes according to the equation:

$$F_{(dbf)} = M\,(K_p\,C_p(t) + K_l\,C_l(t))$$

wherein

$F_{(dbf)}$ relates to the dynamic braking force of the train;

M is the total train mass;

K_p is the corrective factor for the weight increase of the train;

$C_p(t)$ is the braking effect caused by the weight increase;

K_l is the corrective factor for the effect of the lateral friction of the train; and

$C_l(t)$ is the braking effect caused by the lateral friction.

8. (previously presented) A method in accordance with Claim 3 wherein the at least one railcar includes at least one brake shoe, said step of determining a set of consist kinetic elements further comprises the step of determining consist brake forces caused by application of the at least one brake shoe according to the equation:

$$F_{(baf)} = K_{b1} B_1(t) + K_{b2} B_2(t) + K_{b3} B_3(t) + K_{b4} B_4(t)$$

wherein

$F_{(baf)}$ relates to the applied braking forces of the train;

K_{b1} is the brake function coefficient relating to a first segment of the train;

$B_1(t)$ is the brake function relating to the first segment;

K_{b2} is the brake function coefficient relating to a second segment of the train;

$B_2(t)$ is the brake function relating to the second segment;

K_{b3} is the brake function coefficient relating to a third segment of the train;

$B_3(t)$ is the brake function relating to the third segment;

K_{b4} is the brake function coefficient relating to a fourth segment of the train; and

$B_4(t)$ is the brake function relating to the fourth segment.

9. (original) A method in accordance with Claim 8 wherein said step of determining consist brake forces caused by application of the at least one brake shoe further comprises the steps of:

determining friction coefficients of the at least one brake shoe;

determining total brake application forces; and

determining total brake release forces.

10. (previously presented) A method in accordance with Claim 9 wherein said step of determining total brake application forces comprises the step of determining a brake application dragging force using a fast building pressure model according to the equation:

$$Bf_f = \min(0, \max(1, (T + 3.86950758 * T^2 + 0.23164628 * T^3) / (16367.9101 + 111.652789 * T + 27.6134504\,8 * T^2 - 0.0026229 * T^3)))\ Bc_f$$

wherein

Bf_f is the braking force of the train for fast building pressure;

T is the traction force of the train; and

Bc_f is the brake cylinder force of the train.

11. (previously presented) A method in accordance with Claim 9 wherein said step of determining total brake application forces comprises the step of determining a brake application dragging force using a slow building pressure model according to the equation:

$$Bf_s = \min(0, \max(1, (T_s + 2.00986206 * T_s^2 + 0.81412194 * T_s^3) / (0.00067603 + 169.361303 * T_s + 8.95254599 * T_s^2 + 0.58477705 * T_s^3)))\ Bc_s$$

wherein

Bf_s is the braking force of the train for slow building pressure;

T_s is the traction force for the slow building pressure; and

Bc_s is the brake cylinder force of the train.

12. (previously presented) A method in accordance with Claim 9 wherein said step of determining total brake release forces comprises the step of determining brake release using a fast release model according to the equation:

$$Rf_f = \min(0, \max(1, (t + 3.86950758 * t^2 + 0.23164628 * t^3) /$$

$(16367.9101 + 111.652789 * t + 27.6134504\ 8 * t^2 - 0.0026229 * t^3)\ ))\ Bc_f$

wherein

Rf_f relates to the fast release force of the train;

t is the time; and

Bc_f is the brake cylinder force of the train.

13. (previously presented) A method in accordance with Claim 9 wherein said step of determining total brake release forces comprises the step of determining brake release using a slow release model according to the equation:

$$Rf_s = \min(0, \max(1, (t + 2.00986206 * t^2 + 0.81412194 * t^3) / (0.00067603 + 169.361303 * t + 8.95254599 * t^2 + 0.58477705 * t^3)\ ))\ Bc_s$$

wherein

Rf_s relates to the slow release force of the train;

t is the time; and

Bc_s is the brake cylinder force of the train.

14. (previously presented) A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements further comprises the step of determining dynamic brake force according to the equation:

$$F_{(dbf)} = K_d\ D(t)$$

wherein

$F_{(dbf)}$ relates to the dynamic brake force;

K_d is the corrective factor for the effect of the dynamic brake application; and

D(t) is the dynamic brake force of the train.

15. (original) A method in accordance with Claim 3 wherein said step of determining a set of kinetic elements further comprises the step of determining traction force.

16. (original) A method in accordance with Claim 3 wherein said step of determining a force balance further comprises the step of summing the set of consist kinetic elements.

17. (original) A method in accordance with Claim 1 wherein said step of determining a set of consist coefficients comprises the step of using a least squares method to determine consist coefficients.

18. (original) A method in accordance with Claim 17 wherein said step of using the least squares method comprises the steps of:

weighting data;

solving the system; and

determining a confidence measure.

19. (original) A method in accordance with Claim 1 wherein said step of predicting consist characteristic values comprises the steps of:

determining an acceleration prediction;

determining a speed after one minute prediction using the acceleration prediction; and

determining a shortest braking distance prediction using the acceleration prediction.

20. (original) A method in accordance with Claim 19 wherein said step of determining an acceleration prediction comprises the steps of:

determining initial values; and

storing the initial values in the database.

21. (original) A method in accordance with Claim 20 wherein said step of determining an acceleration prediction further comprises the step of determining the acceleration prediction value using a Euler method and the determined initial values.

22. (original) A method in accordance with Claim 20 wherein said step of determining an acceleration prediction further comprises the step of determining the acceleration prediction value using a Milne method and the determined initial values.

23. (original) A system for predicting reactions of a train consist to specific stimuli, said system comprising at least one measurement sensor located on the train consist, a data base, and a computer, the train consist comprising at least one locomotive and at least one railcar, said system configured to:

collect sensor data as the consist is moving;

determine a consist force balance utilizing the sensor data and said computer;

determine a set of consist coefficients using said computer; and

predict train consist kinetic characteristic values using the consist force balance and the set of consist coefficients.

24. (original) A system in accordance with Claim 23 wherein to collect sensor data said system further configured to:

monitor a force applied to the consist utilizing said at least one measurement sensor;

generate force data with respect to the force applied; and

communicate the force data to said computer.

25. (original) A system in accordance with Claim 23 wherein to determine a consist force balance, said system further configured to determine a set of consist kinetic elements.

26. (previously presented) A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine rolling forces according to the equation:

$$F_{(rf)} = M\,(K_r + K_{rv}\,v(t))$$

wherein

$F_{(rf)}$ relates to the rolling forces of the train;

M is the total train mass;

K_r is the corrective factor for friction of the train;

K_{rv} is the dynamic corrective factor for friction of the train; and

v(t) is the speed of the train as a function of time.

27. (previously presented) A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine aerodynamic forces according to the equation:

$$F_{(af)} = K_a\,v(t)^2$$

wherein

$F_{(af)}$ relates to the aerodynamic forces of the train;

K_a is the corrective factor for the effect of the aerodynamic friction; and

v(t) is the speed of the train as a function of time.

28. (previously presented) A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine elevation caused forces according to the equation:

$$F_{(ef)} = M\,(K_{e1}\,E_1(t) + K_{e2}\,E_2(t) + K_{e3}\,E_3(t) + K_{e4}\,E_4(t))$$

wherein

$F_{(ef)}$ relates to the elevation caused forces of the train;

M is the total train mass;

K_{e1} is the corrective factor for the effect of the elevation change on a first segment of the train;

$E_1(t)$ is the elevation function relating to the first segment;

K_{e2} is the corrective factor for the effect of the elevation change on a second segment of the train;

$E_2(t)$ is the elevation function relating to the second segment;

K_{e3} is the corrective factor for the effect of the elevation change on a third segment of the train;

$E_3(t)$ is the elevation function relating to the third segment;

K_{e4} is the corrective factor for the effect of the elevation change on a fourth segment of the train; and

$E_4(t)$ is the elevation function relating to the fourth segment.

29. (previously presented) A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine braking forces caused by direction changes according to the equation:

$$F_{(dbf)} = M\,(K_p\,C_p(t) + K_l\,C_l(t))$$

wherein

$F_{(dbf)}$ relates to the dynamic braking force of the train;

M is the total train mass;

K_p is the corrective factor for the weight increase of the train;

$C_p(t)$ is the braking effect caused by the weight increase;

K_l is the corrective factor for the effect of the lateral friction of the train; and

$C_l(t)$ is the braking effect caused by the lateral friction.

30. (previously presented) A system in accordance with Claim 25 wherein said at least one railcar comprises at least one brake shoe, and to determine a set of consist kinetic elements, said system further configured to determine consist brake forces caused by application of said at least one brake shoe according to the equation:

$$F_{(baf)} = K_{b1} B_1(t) + K_{b2} B_2(t) + K_{b3} B_3(t) + K_{b4} B_4(t)$$

wherein

$F_{(baf)}$ relates to the applied braking forces of the train;

K_{b1} is the brake function coefficient relating to a first segment of the train;

$B_1(t)$ is the brake function relating to the first segment;

K_{b2} is the brake function coefficient relating to a second segment of the train;

$B_2(t)$ is the brake function relating to the second segment;

K_{b3} is the brake function coefficient relating to a third segment of the train;

$B_3(t)$ is the brake function relating to the third segment;

K_{b4} is the brake function coefficient relating to a fourth segment of the train; and

$B_4(t)$ is the brake function relating to the fourth segment.

31. (original) A system in accordance with Claim 30 wherein to determine consist brake forces caused by application of said at least one brake shoe, said system further configured to:

determine friction coefficients of said at least on brake shoe;

determine total brake application forces; and

determine total brake release forces.

32. (previously presented) A system in accordance with Claim 31 wherein to determine total brake application forces, said system further configured to determine a brake application dragging force using a fast building pressure model according to the equation:

$$Bf_f = \min(0, \max(1, (T + 3.86950758 * T^2 + 0.23164628 * T^3) / (16367.9101 + 111.652789 * T + 27.6134504\ 8 * T^2 - 0.0026229 * T^3)))\ Bc_f.$$

wherein

Bf_f is the braking force of the train for fast building pressure;

T is the traction force of the train; and

Bc_f is the brake cylinder force of the train.

33. (previously presented) A system in accordance with Claim 31 wherein to determine total brake application forces, said system further configured to determine a brake application dragging force using a slow building pressure model according to the equation:

$$Bf_s = \min(0, \max(1, (T_s + 2.00986206 * T_s^2 + 0.81412194 * T_s^3) / (0.00067603 + 169.361303 * T_s + 8.95254599 * T_s^2 + 0.58477705 * T_s^3)))\ Bc_s$$

wherein

Bf_s is the braking force of the train for slow building pressure;

T_s is the traction force for the slow building pressure; and

Bc_s is the brake cylinder force of the train.

34. (previously presented) A system in accordance with Claim 31 wherein to determine total brake release forces, said system further configured to determine brake release using a fast release model according to the equation:

$$Rf_f = \min(0, \max(1, (t + 3.86950758 * t^2 + 0.23164628 * t^3) / (16367.9101 + 111.652789 * t + 27.6134504\ 8 * t^2 - 0.0026229 * t^3)))\ Bc_f$$

wherein

Rf_f relates to the fast release force of the train;

t is the time; and

Bc_f is the brake cylinder force of the train.

35. (previously presented) A system in accordance with Claim 31 wherein to determine total brake release forces, said system further configured to determine brake release using a slow release model according to the equation:

$$Rf_s = \min(0, \max(1, (t + 2.00986206 * t^2 + 0.81412194 * t^3) / (0.00067603 + 169.361303 * t + 8.95254599 * t^2 + 0.58477705 * t^3)))\ Bc_s$$

wherein

Rf_s relates to the slow release force of the train;

t is the time; and

Bc_s is the brake cylinder force of the train.

36. (previously presented) A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine dynamic brake force according to the equation:

$F_{(dbf)} = K_d D(t)$

wherein

$F_{(dbf)}$ relates to the dynamic brake force;

K_d is the corrective factor for the effect of the dynamic brake application; and

$D(t)$ is the dynamic brake force of the train.

37. (original) A system in accordance with Claim 25 wherein to determine a set of kinetic elements, said system further configured to determine traction force.

38. (original) A system in accordance with Claim 25 wherein to determine a force balance, said system further configured to sum said set of consist kinetic elements.

39. (original) A system in accordance with Claim 23 wherein to determine a set of consist coefficients, said system further configured to use a least squares method to determine consist coefficients.

40. (original) A system in accordance with Claim 39 wherein to use the least squares, said system further configured to:

weight data;

solve the system; and

determine a confidence measure.

41. (original) A system in accordance with Claim 23 wherein to predict consist characteristic values, said system further configured to:

determine an acceleration prediction;

determine a speed after one minute prediction using said acceleration prediction; and

determine a shortest braking distance prediction using said acceleration prediction.

42. (original) A system in accordance with Claim 41 wherein to determine an acceleration prediction, said system further configured to:

determine initial values; and

store the initial values in said database.

43. (original) A system in accordance with Claim 42 wherein to determine an acceleration prediction, said system further configured to determine the acceleration prediction value using a Euler method and said determined initial values.

44. (original) A system in accordance with Claim 20 wherein to determine an acceleration prediction, said system further configured to determine the acceleration prediction value using a Milne method and the determined initial values.

45. (currently amended) A method for determining a force balance for a train consist using a system including at least one measurement sensor located on the train consist, a data base, and a computer, the train consist including at least one locomotive and at least one railcar, the railcar including at least one brake shoe, said method comprising the steps of:

monitoring a force applied to the consist utilizing the at least one measurement sensor;

generating force data with respect to the force applied;

communicating the force data to the computer;

determining rolling forces according to the equation $F_{(rf)} = M\ (K_r + K_{rv}\ v(t))$,

determining aerodynamic forces according to the equation $F_{(af)} = K_a\ v(t)^2$,

determining elevation caused forces according to the equation $F_{(ef)} = M\ (K_{e1}\ E_1(t) + K_{e2}\ E_2(t) + K_{e3}\ E_3(t) + K_{e4}\ E_4(t))$,

determining braking forces caused by direction changes according to the equation $F_{(dbf)} = M\ (K_p\ C_p(t) + K_l\ C_l(t))$;

determining consist brake forces caused by application of the at least one brake shoe according to the equation $F_{(baf)} = K_{b1}\ B_1(t) + K_{b2}\ B_2(t) + K_{b3}\ B_3(t) + K_{b4}\ B_4(t)$;

determining brake application dragging force using a fast building pressure model according to the equation:

$$Bf_f = \min(0, \max(1, (T + 3.86950758 * T^2 + 0.23164628 * T^3) / (16367.9101 + 111.652789 * T + 27.6134504\ 8 * T^2 - 0.0026229 * T^3)))\ Bc_f;$$

determining brake application dragging force using a slow building pressure model according to the equation:

$$Bf_s = \min(0, \max(1, (T_s + 2.00986206 * T_s^2 + 0.81412194 * T_s^3) / (0.00067603 + 169.361303 * T_s + 8.95254599 * T_s^2 + 0.58477705 * T_s^3);$$

determining brake release using a fast release model according to the equation:

$$Rf_f = \min(0, \max(1, (t + 3.86950758 * t^2 + 0.23164628 * t^3) / (16367.9101 + 111.652789 * t + 27.6134504\ 8 * t^2 - 0.0026229 * t^3)))\ Bc_f,$$

determining brake release using a slow release model according to the equation:

$$Rf_s = \min(0, \max(1, (t + 2.00986206 * t^2 + 0.81412194 * t^3) / (0.00067603 + 169.361303 * t + 8.95254599 * t^2 + 0.58477705 * t^3)))\ Bc_s$$

determining dynamic brake force according to the equation $F_{(dbf)} = K_d\ D(t)$,

determining traction force; and

determining a final solution according to the equation:

$$F(t) = M\,(K_r + K_{rv}\,v(t)) + K_a\,v(t)^2 +$$
$$M\,K_{e1}\,E_1(t) + M\,K_{e2}\,E_2(t) + M\,K_{e3}\,E_3(t) + M\,K_{e4}\,E_4(t) +$$
$$M\,K_p\,C_p(t) + M\,K_l\,C_l(t) +$$
$$K_{b1}\,B_1(t) + K_{b2}\,B_2(t) + K_{b3}\,B_3(t) + K_{b4}\,B_4(t) +$$
$$K_{r1}\,R_1(t) + K_{r2}\,R_2(t) + K_{r3}\,R_3(t) + K_{r4}\,R_4(t) + K_d\,D(t) + K_t\,T(t)$$

wherein

$F_{(rf)}$ relates to the rolling forces of the train;

M is the total train mass;

K_r is the corrective factor for friction of the train;

K_{rv} is the dynamic corrective factor for friction of the train;

v(t) is the speed of the train as a function of time;

$F_{(af)}$ relates to the aerodynamic forces of the train;

K_a is the corrective factor for the effect of the aerodynamic friction;

$F_{(ef)}$ relates to the elevation caused forces of the train;

K_{e1} is the corrective factor for the effect of the elevation change on a first segment of the train;

$E_1(t)$ is the elevation function relating to the first segment;

K_{e2} is the corrective factor for the effect of the elevation change on a second segment of the train;

$E_2(t)$ is the elevation function relating to the second segment;

K_{e3} is the corrective factor for the effect of the elevation change on a third segment of the train;

$E_3(t)$ is an elevation function relating to the third segment;

K_{e4} is the corrective factor for the effect of the elevation change on a fourth segment of the train;

$E_4(t)$ is an elevation function relating to the fourth segment;

$F_{(dbf)}$ relates to the dynamic braking force of the train;

K_p is the corrective factor for the weight increase of the train;

$C_p(t)$ is the braking effect caused by the weight increase;

K_l is the corrective factor for the effect of the lateral friction of the train;

$C_l(t)$ is the braking effect caused by the lateral friction;

$F_{(baf)}$ relates to the applied braking forces of the train;

K_{b1} is the brake function coefficient relating to a first segment of the train;

$B_1(t)$ is the brake function relating to the first segment;

K_{b2} is the brake function coefficient relating to a second segment of the train;

$B_2(t)$ is the brake function relating to the second segment;

K_{b3} is the brake function coefficient relating to a third segment of the train;

$B_3(t)$ is the brake function relating to the third segment;

K_{b4} is the brake function coefficient relating to a fourth segment of the train;

$B_4(t)$ is the brake function relating to the fourth segment;

Bf_f is the braking force of the train for fast building pressure;

T is the traction force of the train;

Bc_f is the brake cylinder force of the train;

Bf_s is the braking force of the train for slow building pressure;

T_s is the traction force for the slow building pressure;

Bc_s is the brake cylinder force of the train;

Rf_f relates to the fast release force of the train;

t is the time;

Rf_s relates to the slow release force of the train;

$F_{(dbf)}$ relates to the dynamic brake force;

K_d is the corrective factor for the effect of the dynamic brake application;

D(t) is the dynamic brake force of the train;

$F(t)$ is the force balance of the train;

K_{r1} is the corrective factor for friction in the first segment of the train;

$R_1(t)$ is the release function of the first segment;

K_{r2} is the corrective factor for friction in the second segment of the train;

$R_2(t)$ is the release function of the second segment;

K_{r3} is the corrective factor for friction in the third segment of the train;

$R_3(t)$ is the release function of the third segment;

K_{r4} is the corrective factor for friction in the fourth segment of the train;

$R_4(t)$ is the release function of the fourth segment; and

K_d is the corrective factor for the effect of the dynamic brake application~~; and~~.